IN THE SPECIFICATION: (Marked up version)

(1) Kindly replace the paragraphs beginning on Page 3 line 12 with the following paragraphs:

Figures 2-4 are cross-sectional views of an illustrative fabrication sequence according to an exemplary embodiment of the present invention.

Figure. 2b illustrates an exemplary sequence for fabricating an oxide layer according to the present invention.

Figure 5 is a graphical representation of time versus substrate current indicative of hot carrier aging (HCA) according to an exemplary embodiment of the present invention and for a conventional device.

(2) Kindly replace the paragraph starting on line 14, page 5 of the as filed application with the following paragraphs:

--Turning now to Figs. 2-4, an illustrative fabrication sequence is described. Figure 2 is the oxide growth sequence used in the formation of oxide layer 16 over the substrate 13, resulting in the formation of a substantially stress free and planar interface 19. ~~The details of this fabrication sequence may be found in U.S. Patent Application (Attorney Docket No. Chen 4-17-133-157), entitled "A Process For Fabricating Oxides", the disclosure of which is specifically incorporated herein by reference. (This patent application is assigned to the assignee of the present invention, and is filed on even date herewith).~~ Referring to FIG. 2b, illustrated is an exemplary sequence for fabricating an oxide layer according to the present invention is shown. Segment 200 indicates a wafer boat push step at an initial temperature of approximately 300°C-700°C, with nitrogen flow of

8.0 L/min and 0.02 to 1% ambient oxygen concentration. These parameters are chosen to minimize the growth of native oxide, which can degrade oxide quality as well as consume the allowed oxide thickness determined by scaling parameters (referred to as oxide thickness budget or scaling budget). Additionally, a load lock system or a hydrogen bake, well known to one of ordinary skill in the art, can be used to impede the growth of this undesirable low-temperature oxide.

Segment 210 is a rapid upward temperature increase at approximately 50-125°C per minute to about 750°C-850°C. This step is carried out at a very low oxygen ambient concentration (on the order of 0.05% to 5%) and a high nitrogen ambient. One aspect of the present embodiment relates to the step of upwardly ramping the temperature at a relatively high rate (segment 210) to minimize the thickness of the oxide formed in this segment (known as the ramp oxide). This helps control the overall thickness of the oxide 16. Thus, through this step, the desired higher growth temperatures (segments 230 and 260) may be attained without sacrificing the oxide thickness budget. Moreover, this rapid rise in temperature at low ambient oxygen concentrations retards the growth of lower temperature oxide, which may be of inferior quality, as discussed above.

Segment 220 is a more gradual increase in temperature. Segment 220 proceeds at approximately 10-25°C per minute. In the exemplary embodiment the temperature reached at the end of segment 220 is in the range of approximately 800°C to 900°C. The same oxygen and nitrogen flows/concentrations used in segment 210 are maintained in segment 220. This control of the ramp up in temperature in segment 220 is also important as it helps to prevent overshooting the growth temperature of segment 230. Finally, the low concentration of oxygen in segment 220 selectively retards the growth of oxide during the temperature increase to a higher growth temperature. Again this helps to preserve the oxide thickness budget.

Segment 230 is a low temperature oxide (LTO) growth step. In this step, the ambient oxygen concentration is about 0.1% to about 10% while the ambient nitrogen concentration is 90-99.9%. Dichloroethylene may be added at 0-0.5% for a time that is dependent upon the desired thickness as would be appreciated by one of ordinary skill in the art. At the end of segment 230, an anneal in pure nitrogen may be carried out. In the illustrative sequence of FIG. 2b, during segments 200-220 an oxide is grown having a thickness in the range of .5-1.0 nm. Segment 230 results in the growth of approximately .25-1.0 nm of oxide. Upon completion of segment 230, the growth of the first oxide portion is completed. Illustratively, this first oxide portion is grown at a temperature lower than the viscoelastic temperature of silicon dioxide (T_{ve}), which is approximately 925°C. The first oxide portion may comprise 25-98% of the total thickness of the oxide layer. In an exemplary embodiment in which the oxide layer 16 has a thickness of 3.0 nm or less, the first oxide portion has a thickness of approximately .75-2.0 nm. As discussed more fully herein, applicants theorize that the first oxide portion acts as a sink for stress relaxation that occurs during the growth of second oxide portion under first oxide portion.

Segment 240 is the first segment in the temperature increase to a temperature above the viscoelastic temperature of silicon dioxide. This ramp up in temperature occurs relatively slowly, at a rate of approximately 5-15°C per minute and in a nearly pure, nitrogen ambient (the ambient concentration of oxygen in this segment is illustratively 0%-5%). The temperature reached at the end of segment 240 is approximately 50°C below the high temperature oxide (HTO) growth temperature of segment 260. Segment 250 is a modulated heating segment in which the temperature is increased at a rate of approximately 5-10° C per minute to a temperature above the viscoelastic temperature. In the illustrative embodiment the HTO growth temperature is in the range of 925-1100°C. The same

flows/concentration of oxygen and nitrogen of segment 240 are used in segment 250. At the end of segment 250, the HTO growth temperature is reached.

Segments 240 and 250 are useful steps in the exemplary embodiment of the present invention. As was the case in the temperature ramp-up to segment 230 the (LTO growth segment) the careful ramp-up of temperature in segments 240 and 250 prevents overshooting the desired growth temperature, in this case the HTO growth temperature of the present invention. The rate of temperature increase at the illustrated low ambient oxygen concentration is useful in retarding oxide growth thereby preserving the oxide thickness budget. Finally, applicants believe that the careful heating in a low oxygen ambient in segments 240 and 250 reduces growth stress, and consequently reduces the occurrence of oxide growth defects (e.g., slip dislocations and stacking faults).

Segment 260 is the HTO growth step, where the growth temperature is illustratively above the viscoelastic temperature of silicon dioxide. The temperature achieved at the end of segment 250 is maintained in the growth step in segment 260 in a 25% or less oxygen ambient for approximately 2 to 20 minutes so that an additional .2-1.2 nm of oxide may be grown at high temperature. The second portion may comprise on the order of 2-75% of the total thickness of the oxide layer 16. The final portion of segment 260 may include an anneal in pure nitrogen. Applicants believe (again without wishing to be bound to such a belief) that the high temperature growth above the viscoelastic temperature (approximately 925°C) results in the growth of an oxide (second oxide portion 32) having certain properties.

Segment 270 of the exemplary embodiment of FIG. 2b is a cooling segment also referred to as a modulated cooling segment. A temperature ramp down is carried out at a rate of approximately 2-5°C per minute to a temperature at the end of segment 270 which is below the

<u>viscoelastic temperature. For example, the temperature reached at the end of segment 270 is in the range of 900-800°C Segment 270 is carried out in a nearly pure nitrogen ambient, which is inert. During the cooling of a grown oxide to below the viscoelastic temperature, stress may result in the oxide, particularly at the substrate-oxide interface. As a result of this stress, defects such as slip dislocations and oxidation induced stacking faults may be formed at energetically favored sites such as heterogenities and asperities. These defects may be viewed as routes for diffusional mass transport and leakage current paths which can have a deleterious impact on reliability and device performance. The modulated cooling segment, and the stress absorbing or stress sink characteristics of the first oxide portion (particularly during the modulated cooling segment) results in a substantially stress free oxide-substrate interface. Moreover, the defect density is reduced. Finally, segment 280 represents a further ramp down at a faster rate on the order of approximately 35-65°C per minute in an inert ambient such as pure nitrogen. Segment 290 is the boat pull at about 500°C in a pure nitrogen ambient.</u> Thereafter, as shown in Fig. 3, the gate structure 11 is completed via conventional processing schemes which may include: deposition of a high-k layer; amorphous silicon or polycrystalline silicon deposition, gate implantation and gate masking steps.--

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Segment 210 is a rapid upward temperature increase at approximately 50-125°C per minute to about 750°C-850°C. This step is carried out at a very low oxygen ambient concentration (on the order of 0.05% to 5%) and a high nitrogen ambient. One aspect of the present embodiment relates to the step of upwardly ramping the temperature at a relatively high rate (segment 210) to minimize the thickness of the oxide formed in this segment (known as the ramp oxide). This helps

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Segment 220 is a more gradual increase in temperature. Segment 220 proceeds at approximately 10-25°C per minute. In the exemplary embodiment the temperature reached at the end of segment 220 is in the range of approximately 800°C to 900°C. The same oxygen and nitrogen flows/concentrations used in segment 210 are maintained in segment 220. This control of the ramp up in temperature in segment 220 is also important as it helps to prevent overshooting the growth temperature of segment 230. Finally, the low concentration of oxygen in segment 220 selectively retards the growth of oxide during the temperature increase to a higher growth temperature. Again this helps to preserve the oxide thickness budget.

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